

**Statement of Work  
For the Refurbishment of the Engineering Model  
AMSU-B**

**Contract NAS5-96086  
Attachment A, Statement of work  
April 1996**

Prepared for:  
National Aeronautics and Space Administration  
Goddard Space Flight Center  
Greenbelt, Maryland



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STATEMENT OF WORK  
AMSU-B FM-4/HSB

March 1999

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MOD5**1.0 DELIVERABLE ITEM(S)**

- (a) The AMSU-B engineering model (EM) shall be refurbished and upgraded to provide a suitable AMSU-B flight spare instrument for NOAA-M. In addition to serving as a flight spare the instrument shall be available for performing investigative tests in support of the AMSU-B flight model on the NOAA-K spacecraft and shall be fully operable during a period of 3 months before and 3 months after the NOAA-K launch. The launch is defined as the period extending from August 20 to September 6, 1997. In the event of launch delay the status of the EM as an investigative instrument shall be re-evaluated by the NASA/GSFC in consultation with the UK Met Office and new direction shall be provided by NASA/GSFC within 30 days following the delay announcement. The upgraded instrument shall be defined and characterized by the UK Met Office Instrument Specification for AMSU-B Flight Model 4, M/RSI/23/14, Issue 1.
- (b) The contractor shall verify the existing AMSU-B thermal design and verify by test instrument EMI/EMC performance out to more stringent and demanding limits than currently in place for the NOAA series of spacecraft. This shall be done by utilizing the Humidity Sounder for Brazil (HSB) instrument. The HSB shall be thermally modified to be compatible with the EOS-PM spacecraft and EMI/EMC tested to the EOS-PM requirements. The HSB instrument is a build-to-print copy of the NOAA series AMSU-B and will fly on the NASA GSFC EOS-PM Spacecraft. Deliverable items shall consist of a summary report concluding the activities associated with the HSB instrument provided in paragraph 1.1.2 of this statement of work.

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Upon acceptance of the refurbished AMSU-B EM as FM-4 at the Preshipment Review, the instrument shall be shipped to NASA/Goddard Space Flight Center via World Trade Transport at Dulles Airport, Virginia. Accompanying the shipment of FM-4 shall be copies of the End Item Data Package and Data Delivery Package per Paragraph 6.2 of this Statement of Work.

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Other deliverable items shall consist of the EM characterization plan, acceptance test plan, local oscillator qualification plan, new parts and materials lists, non-standard parts approval requests, and monthly progress reports as specified in the body of this Statement of Work.

## 1.1 PROJECT MANAGEMENT

The UK Met Office shall appoint a Project Manager to manage the overall refurbishment and upgrade effort and the personnel necessary to conduct the associated functions. In addition, the Project Manager shall maintain cognizance over all subcontracts associated with the program to ensure that the contractual requirements are being properly implemented. The Project Manager shall also interface with the NASA/GSFC AMSU-B COTR/Instrument Manager to update status and to conduct the exchange of required documentation.

The program involves only replacement, retest, and recalibration, therefore, support to project management shall consist of the necessary personnel to conduct these functions. In addition, a Product Assurance Manager shall be provided to monitor these activities and maintain material, process, and procedural control.

### 1.1.1 Program

The refurbishment program shall consist of, but not be limited to, the following activities:

#### 001 Program Management

Ensure all tasks are completed satisfactorily and according to schedule.

Produce monthly reports of progress.

Attend periodic progress reviews.

Arrange and support a Preliminary Design Review (PDR), Critical Design Review (CDR) and Pre-Shipment Review (PSR).

Attend interface meetings with NASA/NOAA.

Initiate and maintain a configuration control system.

#### 002 Product Assurance

Review procedures for refurbishment of the AMSU-B EM.

Review and approve new materials and processes.

Prepare new materials list.

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Prepare Non-Standard Parts Approval Requests and generate new parts list.  
 Carry out incoming acceptance inspections.  
 Ensure the acquisition of test data from subcontractors or vendors where required.  
 Maintain a file of all test data.  
 Review all proof testing.  
 Review NCR's and attend MRB's.  
 Attend test readiness reviews.  
 Certify calibration standards  
 Ensure contamination control.  
 Ensure electrostatic discharge prevention.  
 Support periodic reviews.  
 Maintain a rework and test log.

### 003 Space Blanket Manufacture

Provide specifications to subcontractors.  
 Procure blankets and fixing studs.  
 Mount studs to instrument.  
 Fit check blankets to instrument.  
 Bake out blankets and seal in packing material.

### 004 Motor Bearings and Shroud Replacement

Write specifications for subcontractors.  
 Procure replacement parts.  
 Disassemble instrument scan mechanism.  
 Fit replacement parts.

### 005 Feed Horns and Local Oscillator Replacement

Write hardware specifications.  
 Write Invitations To Tender for hardware.  
 Place contracts for hardware.  
 Inspect and test incoming hardware.  
 Install local oscillators in all three channels with new feed horns on each mixer.  
 Test system environmentally.

### 006 On-Board Calibration Target (OBCT) Upgrade

Prepare Platinum Resistance Thermometer (PRT) specification.  
 Procure PRT's to specification.  
 Calibrate PRT's.  
 Drill out defective PRT's  
 Replace and wire up PRT's.

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Calibrate OBCT.

#### 007 Printed Circuit Board (PCB) Modifications

Prepare requirements specification.  
 Develop new PCB circuit diagrams and layout.  
 Breadboard and develop single event upset protection for  
 the specified circuits.  
 Procure necessary components.  
 Subcontract PCB manufacture.  
 Test or contract out testing of PCB's.  
 Install PCB's into system (Processor Electronics Unit).  
 Environmentally test system.

#### 008 Instrument Assembly, Integration, and Testing (AIT)

Coordinate with Product Assurance (PA) in the development  
 of a PA Requirements Specification .  
 Prepare an alignment specification.  
 Write assembly requirements.  
 Assemble instrument.  
 Write alignment requirements.  
 Write alignment equipment specification.  
 Procure alignment equipment.  
 Align instrument.  
 Environmentally test instrument.

#### 009 Acceptance Testing

Prepare acceptance testing specification.  
 Perform acceptance testing per the requirements of GSFC  
 S-480-40, Rev. N, Appendix D, except as modified by this  
 Statement of Work.

#### 010 Characterization

Issue a characterization plan.  
 Fully characterize FM-4 per plan.  
 Produce a calibration book.

#### 011 Bench Test Equipment (BTE) Maintenance

Prepare requirements specification for BTE maintenance.  
 Arrange for maintenance of VAX computer.  
 Maintain serviceability of Aerojet supplied equipment.

### 1.1.2 Upgrade Requirements

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1.1.2.1 In order to upgrade the AMSU-B EM to FM-4 certain changes will be necessary. The replacements, modifications, and additions to effect those changes shall be as follows:

- (a) Printed circuit boards requiring changes for single event upset protection shall be modified.
- (b) New local oscillators (89, 150, and 183.3 GHz frequency) shall be procured to replace the existing oscillators. They shall be of the same form, fit, and function as those being replaced, and also built to the same high reliability standards. Qualification of the oscillators shall be the responsibility of the UK Met Office and shall consist of thermal vacuum temperature cycling.
- (c) The feed horns shall be replaced with components having quality and reliability requirements equivalent to those specified for AMSU-B FM's 1, 2, and 3.
- (d) The scan mechanism bearings shall be replaced with bearings having quality and reliability requirements equivalent to those specified for AMSU-B FM's 1, 2, 3, and identical to those previously qualified for the FM's.
- (e) The antenna shroud shall be replaced with a flight standard shroud as designed for the three AMSU-B flight models.
- (f) Two sets of thermal blankets, one set for AM use and the other for PM use shall be tailored and additionally baked out.
- (g) The defective temperature sensors in the OBCT shall be replaced and the OBCT subsystem then calibrated.

1.1.2.2 Modifications to the HSB instrument design and testing to provide enhanced AMSU-B design and performance characteristics beyond what was originally envisioned shall be as follows:

- (a) Addition of a radiator to the Power Supply Unit
- (b) Double the size (from 192 cm<sup>5</sup> to 394 cm<sup>5</sup>) of the scanning mechanism radiometer.

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- (c) Adjust the HSB Reduced Thermal Math Model to reflect the items (a) and (b) above.
- (d) Update existing AMSU-B EMI/EMC test procedures to comply with the requirements specified in the EOS-PM General Interface Requirements Document (GSFC 422-11-12-01).
- (e) Conduct the instrument EMI/EMC testing in accordance with requirements in item (d) above.

### 1.1.3 Parts and Materials Lists and Reviews

A list of all new materials (materials not previously used in FM 1, 2 or 3) shall be submitted to the GSFC for review and approval as required in Paragraph 6.0 of the GSFC Performance Assurance Requirements (GSFC S-480-40, Rev. N). All new parts selected for use in interface circuits shall require the submission of Non-Standard Parts Approval Requests to the GSFC for review and approval when such parts are non-standard as specified in Paragraph 5.2.2 of GSFC S-480-40, Rev. N.

### 1.1.4 Critical Longlead Spares

All critical longlead spares listed in Section J, Attachment C of the contract Schedule shall be interchangeable between all flight models.

## 2.0 TESTING REQUIREMENTS

Testing shall consist of system level tests, thermal vacuum characterization, and proof tests. The system level tests shall be for the purpose of verifying flight performance and standards, and shall be conducted as defined in the Performance Assurance Requirements (PAR) Specification GSFC S-480-40, Rev. N, and the British Aerospace Instrument System Specification SYS/AMS/J0105/BAC, Issue 3. A characterization plan shall be issued and characterization shall be as performed on the other three AMSU-B flight models. Proof tests to verify performance, as related to the required configuration changes, shall be performed in lieu of full acceptance testing, and shall be as shown below:

- (a) Scan health check.
- (b) Local oscillator (LO) check.
- (c) Total system noise temperature (Tsys).

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- (d) Noise equivalent temperature difference (NE $\Delta$ T).
- (e) 1/f knee frequency to confirm calibration value averaging.
- (f) Single axis vibration acceptance test per GSFC S-480-40, Rev. N.
- (g) EMI tests at SAR levels only.
- (h) Thermal vacuum per GSFC S-480-40, Rev. N, except that only two cycles shall be performed.

## 2.1 Testing Plans

Two copies (one to NASA/GSFC and one to NOAA/GSFC) each of the characterization test plan, acceptance test plan, and local oscillator qualification plan shall be submitted for review and approval at least four weeks before each test is scheduled to be run.

## 3.0 SPACECRAFT INTERFACE

The spacecraft interface shall be as defined in the GIIS, IS3267415, Rev. C, and the UIIS, IS2613442, Rev. M.

## 4.0 PROGRAM REVIEWS AND REPORTS

### 4.1 Reviews

The UK Met Office shall conduct a PDR, a CDR, and a PSR including acceptance and buy off of FM-4. Attendance at each of these reviews shall consist of NASA/GSFC and NOAA personnel. The reviews shall be as defined in Paragraphs C.2b, c, and d of the original Memorandum of Working Arrangements for AMSU-B (dated 8/10/92).

### 4.2 Reports

The UK Met Office shall submit a monthly progress report on the EM refurbishment and testing status, problems, schedule progress, quality assurance, and updated milestone charts. Two copies (one to NASA/GSFC and one to NOAA/GSFC) shall be submitted.

## 5.0 POST DELIVERY SUPPORT

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The UK Met Office shall support: (a) spacecraft level testing, thermal vacuum testing, and any other testing deemed necessary on FM-4 at the spacecraft contractor's plant in East Windsor, NJ; (b) pre-launch testing and activities (as concerns FM-4) at the Western Space and Missiles Center, Vandenberg Air Force Base, CA; (c) post-launch activities at NOAA/SOCC, Suitland, MD; and (d) the evaluation of data from the tests at all sites noted.

## **6.0 SHIPMENT AND STORAGE**

### **6.1 Instrument Shipment/Storage**

The UK Met Office shall be responsible for shipping FM-4 to the USA in a suitable container as described in Paragraph 8 of the Memorandum of Understanding, dated February 14, 1986, and C.2d of the Memorandum of Working Arrangements, dated August 10, 1992. The storage of AMSU-B shall be maintained with the instrument in the shipping container.

### **6.2 Data Shipment**

An End Item Data Package (EIDP) shall be provided with the instrument shipment. Three copies shall be required with one set to be delivered to NASA/GSFC, one set to NOAA/GSFC, and the other to Lockheed Martin Missiles and Space. The EIDP shall be identical to those submitted for previous AMSU-B flight models and, in addition, shall contain documentation detailing changes in components, materials, parts, drawings, and procedures.

Eight copies of the data delivery package summarizing the calibration data, algorithms, coefficients, limits, ranges of parameters, PRT and thermocouple characteristics, and warning flag limits shall also be supplied with the instrument shipment. Two copies shall be delivered to NASA/GSFC and six copies to NOAA/GSFC.

STATEMENT OF WORK  
AMSU-B FM-4

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Date

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